ECONOMICS

The Demography of Educational Attainment and Economic Growth

Complementing primary education with secondary education in broad segments of the population is likely to give a strong boost to economic growth.

Wolfgang Lutz,[1]* Jesus Crespo Cuaresma,[2] Warren Sanderson[3]

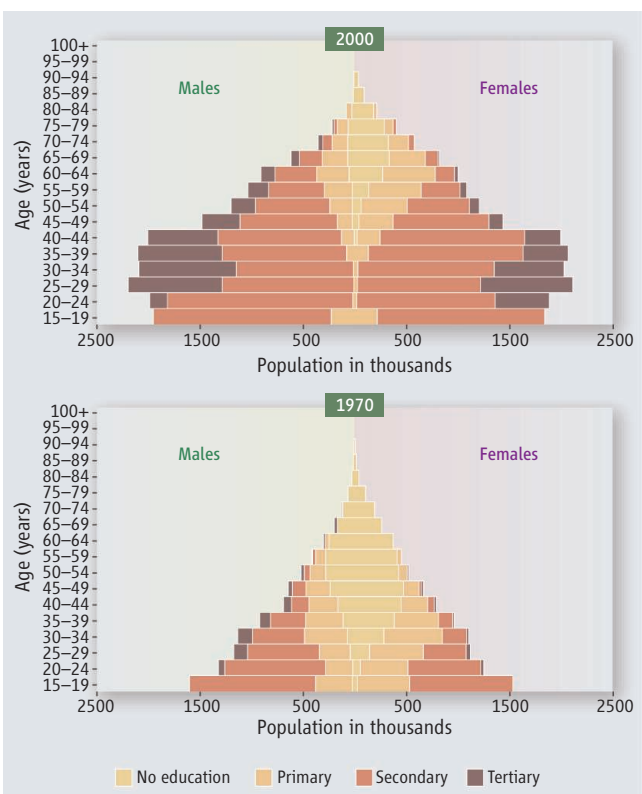
When the world leaders convened in New York in 2000 and solemnly announced the United Nations (U.N.) Millennium Development Goals (MDGs), the goal of universal primary education by 2015 figured prominently, second only to the reduction of extreme poverty and hunger. Although the diminution of poverty and hunger is a self-evident end in itself, putting all children into school is a goal primarily because it is believed to be the vehicle through which the level of adult human capital is improved, in turn enhancing individual well-being, health, and economic growth. The empirical basis for assuming an important positive effect of education on economic growth is, however, surprisingly weak. Although it is well established that, at the individual level, more years of schooling lead to higher income, at the macroeconomic level, the empirical evidence, so far, relating changes in education measures to economic growth has been ambiguous.

The MDG's focus on universal primary education has to be seen in the context of the evolution of international concerns about eradicating illiteracy with a series of well-intended but "demographically illiterate" and therefore unrealistic goals, which ultimately failed. In 1990 at a historical conference in Jomtien (Thailand), 155 governments and 150 organizations issued a World Declaration on Education for All that included the prominent goal of reducing the adult illiteracy rate to one-half of its 1990 level by the year 2000. From a demographic perspective, it is clear that this goal is impossible to achieve in poorly educated countries if education is primarily concentrated in young people, because it would take many decades for the better-educated youngsters to replace the illiterate adult population. Ten years later in Dakar, the international community, confronted with the failure of the previous goals, chose to use an even more unfortunate formulation of their goal, namely, "increase the literacy rate by 50%," which, for countries that already had more than 66.7% literacy, implied a goal of more than 100%. To correct this evident political innumeracy, the U.N. Educational, Scientific, and Cultural Organization (UNESCO) later modified the goal to imply a goal of 100% for countries that already had 66.7% literacy or more. Leaving aside the fact that 100% literacy may be impossible to reach for any society, even this revised goal focuses on the stock of adult literacy without considering the cohorts involved.

The MDG's focus on enrollment in formal primary education is related but somewhat different from the earlier focus on literacy: Literacy is a skill that, in principle, can also be acquired outside the regular education system and that can be lost again (secondary illiteracy). In contrast, once a certain level of educational attainment is reached, it cannot be lost again throughout the rest of our lives. We will be able to keep our doctorates even if our skills seriously degrade; this property actually makes educational attainment distributions easier to model because movements can only go in one direction, toward higher education.

Using the demographic method of multistate back projection, a group of researchers at the International Institute for Applied Systems Analysis (IIASA) and the Vienna Institute of Demography (VID) has recently completed a full reconstruction of educational attainment distributions by age and sex for 120 countries for the years 1970–2000 (*1*). This improvement in human capital is illustrated (see figure, below) along cohort lines in the case of South Korea. The advantages of this data set relative to others (*2*–*4*) are its detail (four educational categories for 5-year age groups of men and women), its consideration of differential mortality, and its strict consistency of the definition of educational categories over time. The age and education composition detail in our new data allow us to perform more detailed statistical analyses of the relation between education and economic growth than can be performed using preexisting data.

Previous cross-country economic growth regressions tended to show that changes in educational attainment are largely unrelated to economic growth [for example, (*5*, *6*)], which contradicts theory and microeconometric evidence. Most of the literature in this field attributes the existence of this puzzle to



Reconstructing educational attainment. (**Top**) Age pyramid of South Korea in 2000 with colors indicating different educational attainment categories. (**Bottom**) Reconstructed age pyramid of South Korea in 1970 with colors indicating different educational attainment categories.

[1]Vienna Institute of Demography (Austrian Academy of Sciences), A-1040 Vienna, and World Population Program, International Institute for Applied Systems Analysis (IIASA), Schlossplatz 1, A-2361 Laxenburg, Austria. [2]University of Innsbruck, A-6020 Innsbruck, and World Population Program, IIASA. [3]Stony Brook University, Stony Brook, NY 11794, USA, and World Population Program, IIASA.

*Author for correspondence. E-mail: lutz@iiasa.ac.at

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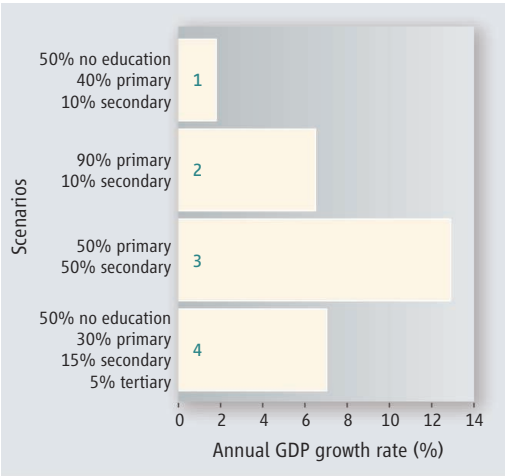
deficiencies in the series of education data (*3*, *4*, *7*). Also, averaging education attainment data over longer horizons has led to more consistent patterns (*8*), which highlights the importance of measurement problems in the previous data.

Using our new educational attainment data by age groups, we estimated simple growth regressions based on 5-year periods for a panel of 101 countries for which all the necessary economic and education data exist over the period 1970–2000. It has a fair representation of all continents (*9*). These new data allow us to use the education levels of different age groups as potential determinants of economic growth. The results show consistently positive, statistically significant education effects on economic growth for some age and education groups (*9*) and, hence, make the puzzle disappear.

In our model, human capital by broad age groups enters production both as differentiated labor force inputs and through the absorption rate of new technologies, which, in turn, depends on the interaction between human capital and distance to the technological frontier [see (*5*) for a similar approach]. The effect of education on labor force participation is assumed to be specific to each age and education group and constant over time. The model is described, related to the literature, and justified in detail (*9*).

The implications of the results and the value added by the new data set are illustrated by simulating four scenarios based on estimated coefficients (see figure below, table S1, and the discussion in the supporting online text). These four roughly resemble alternative hypothetical education policy strategies for a poor African country. In these simulations, we focus on the fact that economic growth is determined by the adoption of new technologies, and that the size of the effect depends on the income level of the country under study, because countries that are further away from the technology frontier are able to profit more [in terms of Gross Domestic Product (GDP) growth] from this channel of the education-growth link.

The figure above presents the average annual GDP growth rates corresponding to different education level distributions. Scenario 1 presents the reference case of a country with a young age structure (70% of the population in the 15- to 40-year-old group and 30% in the 40- to 65-year-old group), a low starting level of income and investment rate and the following educational structure: half of the population without any formal schooling, 40% with some primary and 10% with at least completed junior secondary



Annual GDP growth rates according to the four alternative educational attainment distributions (see text).

school (but no tertiary education). The education groups used in the analysis (no education, primary, secondary, and tertiary) are nonoverlapping. This roughly fits the demographic structure of some Latin American and African countries in our sample, e.g., Guatemala, Honduras, Kenya, Rwanda or Uganda. On the basis of the estimated model, such a country would have rather slow economic growth. Scenario 2 considers the otherwise identical country under the hypothetical assumptions that it has for long met MDG goal 2 and that the previously uneducated half of the adult population now has primary education. This case would lead to somewhat higher average growth of GDP. Scenario 3 considers a possible new MDG effort that adds widespread secondary education (we assume here 50% of the population achieving at least some secondary schooling) to universal primary. The model simulations indicate that this additional investment in secondary education provides a huge boost to economic growth, over five times the level of the baseline scenario and also much more than in the scenario of universal primary education alone.

Scenario 4 finally presents another possible direction of improvement from the baseline (which somewhat resembles the case of India), in which half of the population remains without education although 5% have tertiary education, 15% secondary, and 30% primary. This case of elitist education in a context with half of the population being without any schooling does clearly better than the baseline and even better than the universal primary education (combined with 10% secondary and no tertiary), but falls far short of the economic growth implied by universal primary combined with 50% secondary and no tertiary education.

We compared these results with an age-aggregated version of the IIASA-VID data and the widely used Barro-Lee (*2*) data set, which has no age detail (see table S2). The comparison with the full age-structured model gives evidence of differences across age groups in the effects of education on GDP growth (table S1). These results point to the importance of the demographic structure of human capital when assessing the effect of education on economic growth. The IIASA-VID data set is, as of today, the only comprehensive data set offering such demographic detail in education figures.

These new findings have political consequences for the next round of defining international education goals (*10*): The current MDG's focus on universal primary education is important but insufficient. It needs to be complemented with the goal of giving broad segments of the population at least a completed junior secondary education. Only this is likely to give initially poor countries the human capital boost that is necessary to bring large segments of the population out of poverty. For more industrialized countries, tertiary education of younger adults also is an important determinant of economic growth.

In conclusion, better education does not only lead to higher individual income but also is a necessary (although not always sufficient) precondition for long-term economic growth. The fruits of investments in education need a long time to ripen, to translate the education of children into better human capital of the adult labor force. Education is a long-term investment associated with near-term costs, but, in the long run, it is one of the best investments societies can make in their futures.

References and Notes

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Supporting Online Material
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